

INTERMEDIATE/SECONDARY Article: New Approach to Biomass

Biomass Program

Developing new technologies to release the energy stored in plants is one of the targets for the Biomass Program of the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy (EERE). Two areas currently in development are known as the sugar platform and the thermochemical platform.

Sugar Platform

Current technology converts plant sugars and starches to ethanol. Easy to extract sugars and starches are typically found in plant seeds. The EERE sugar platform focuses on the bulk of plant material—cellulose, hemicellulose and lignin. Using cellulose and hemicellulose to make ethanol requires breaking them down into their component sugars. Once in sugar form, the cellulose and hemicellulose can be used by a biorefinery to make ethanol or other chemicals that are building blocks for industrial uses. Lignin can be used as a fuel for generators or converted into chemicals.

Breaking down bulky plant material can be done in a variety of ways. Current industry practice involves using either concentrated or dilute acid solutions to break down the cellulose and hemicellulose into sugars. Since both of these practices have been researched and in use for some time, EERE believes they have reached much of their sugar extracting potential. Thus the focus of the Biomass Program is on enzymatic hydrolysis.

Enzymatic hydrolysis starts with mechanical milling, or physically breaking down the plant material. Next, a pretreatment of a dilute acid occurs. This step breaks down the hemicellulose and starts to deteriorate some of the lignin surrounding the more resistant cellulose. EERE Biomass Program researchers are currently determining the best pretreatment process. Cellulase, an enzyme that breaks down cellulose into sugars, is then introduced into the solution. The resulting batch of sugars can be fermented into ethanol or processed into other products. The EERE Biomass Program is also researching a process that involves the simultaneous enzymatic breakdown of cellulose and fermentation of sugars into ethanol by microbes.

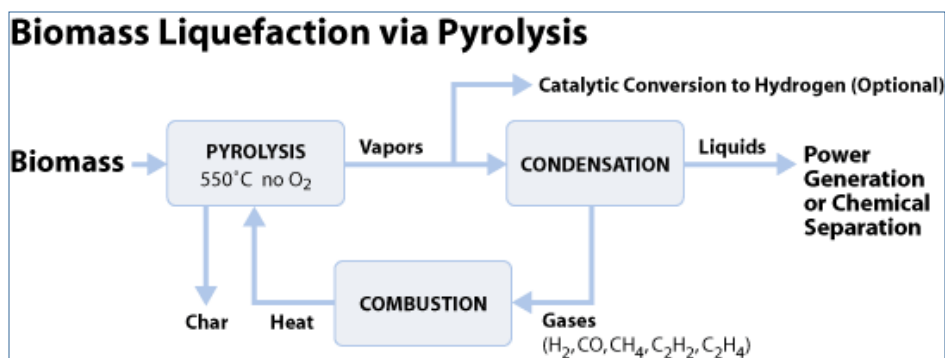
The goal of the new technology is to enable biorefineries to produce valuable chemicals and products that will alleviate the nation's dependence on foreign oil and reduce net greenhouse gas emissions with plant materials not fully utilized with current technologies.

Thermochemical Platform

While burning solid biomass has been a primary way of drawing energy out of plants since prehistoric times, it is a fairly inefficient process. The EERE Biomass Program is researching gasification and pyrolysis methods of converting solid biomass to either gaseous or liquid fuels to better tap into the stored energy.

Gasification involves heating biomass with little to no oxygen present. This process does not allow the biomass to combust. Instead, it gasifies into a mixture of carbon monoxide and hydrogen known as synthesis gas or **syngas**. As gaseous fuels mix more readily with oxygen than solid fuels, syngas burns more efficiently and cleanly than solid biomass. Additionally, syngas can be burned in more efficient gas turbines to make electricity or mixed with chemical catalysts to make liquid fuels.

Pyrolysis, causing something to change due to heat, is another way to change solid biomass into a more efficient form, in this case a liquid. Similar to gasification, pyrolysis involves heating solid biomass in a limited oxygen environment. Biomass liquids can be used directly as fuel for power generation, converted to transportation fuels, or used to produce high-value chemicals and materials. Current research looks at reducing the energy and financial costs associated with pyrolytically produced biofuels.



Credit: DOE EERE Biomass Program

For more information about biomass technologies, visit www1.eere.energy.gov/biomass/technologies.html.